- there is a less variability in both the medians and the maximums in the 1992-93 CO season than in previous seasons

The daily medians and maximums were then used to calculate monthly box plot statistics; these plots are shown in Appendices H and I. The box plots shown within Appendix H group the daily medians and maximums of hourly carbon monoxide readings by successive months over different CO seasons whereas Appendix I shows the same data but grouped by same month over different years.

Although carbon monoxide levels change daily due to fluctuations in traffic intensity and atmospheric patterns, Appendix H indicates that there is little difference in the monthly medians over a CO season from a standpoint of confidence interval significance. For instance, there is an increase in urban traffic during the holiday shopping season and the air patterns over North Carolina do tend to get less stable as winter progresses with more mixing of air pollutants in February than in November. Apparently, neither of these phenomena is sufficient for ambient carbon monoxide levels at the individual monitoring stations to statistically differ on a monthly basis.

Examination of the box plots of daily maximums in Appendix H shows more variation in the data than the box plots of the daily medians. This is to be expected since the medians are a central tendency statistic computed from 24 hourly observations whereas the daily maximum is only one value (because central tendency statistics aggregate data, they dampen variability). However, even with this increased variability there are very few box plots with non-overlapping confidence intervals across a CO season. Thus we can conclude that the daily maximums, like the daily medians, do not significantly change on a month-to-month basis over a single CO season.

The box plots shown in Appendix I compare the data by the same months over the four CO seasons. This enables trends to be observed on an annual basis. Even though the box plots in Appendix H demonstrate that there is little month-to-month change during an individual CO season, it was considered possible that there was change, by month, on an annual basis. Close examination of Appendix I shows that while the monthly medians for the 1992-93 CO season are seldom different from corresponding months in other CO seasons (at the 95% level of confidence), some downward trend is clearly visible.

Comparative bar charts, comprised of only the monthly medians and maximums, are used in Appendix J to illustrate the relationships between stations within and outside the oxygenated fuel area. The charts are additionally grouped by sampling site type (this was discussed earlier - i.e., shopping mall sites or downtown sites). Looking at the median values (Appendices J.1 and J.2), it appears that for most stations there was a slight drop in ambient carbon monoxide levels during the 1992-93 season; note, however, the February bar chart for Raleigh 0011 where median carbon monoxide levels rose each succeeding year. The same trends hold fairly well for the maximums (Appendices J.3 and J.4), except for the month of November at all of the downtown sampling sites and for the month of January at two of the shopping mall sites.

Appendix J shows that while median values were lower overall for the downtown sampling sites as compared to the shopping mall sites (compare Appendices J.1 and J.2), the reverse was true for the maximum values (compare Appendices J.3 and J.4). This phenomena is readily apparent when re-examining the time lines shown in Appendix F; one can see that there is much more variation in the data from downtown sites. This is probably due to daily and weekly variations in the employment-related traffic patterns of downtown areas.

Finally, Appendix K summarizes the complete dataset used for this analysis. This is done by station and CO season for the years 1989 through 1993. Appendix K.1 depicts the monthly median of the daily medians of the 24 hourly readings while Appendix K.2 shows the monthly maximum of the daily maximums of the same readings.

CONCLUSIONS AND RECOMMENDATIONS

With respect to the impact of oxygenated fuel use on ambient carbon monoxide levels in urban areas, this study concludes that, overall, there is no statistically significant difference between the CO season when the oxygenated fuel program was in effect and the previous three CO seasons when it was not. However, individual station analyses indicate that modest, localized improvements may have been realized.

Even though there was a slight downward trend of ambient carbon monoxide over time at many of the sampling sites, this phenomena does not appear to be unique for only stations in the oxygenated fuel areas.